United States
Department of
Agriculture

**Forest
Service**

Forest
Products
Laboratory

Dividends From Wood Research

NAT/ NDB

Recent Publications

July—December 1993

Explanation and Instructions

"Dividends From Wood Research" is a semiannual listing of recent publications resulting from wood utilization research at the Forest Products Laboratory (FPL). These publications are produced to encourage and facilitate application of Forest Service research. This issue lists publications received from the printer between July 1 and December 31, 1993.

Each publication listed in this brochure is available through at least one of the following sources.

Available from FPL (indicated by an order number before the title of the publication): Quantities limited. Circle the order number on the blank at the end of the brochure and mail or FAX the blank to FPL.

Available through sales outlets (indicated by the name of the outlet and, when available, price information) : Major sales outlets are the Superintendent of Documents, the National Technical Information Service (NTIS), and various private publishers. Order directly from the outlet.

Available through libraries: Research publications are available through many public and university libraries in the United States and elsewhere. U.S. Government publications are also available through many Government Depository Libraries. Check with a major library near you to determine availability.

List of Categories

Publications are listed in this brochure within the following general categories:

Biodeterioration and Protection

1. Pyrolysis, Leach Resistance, Hygroscopicity, and Decay Resistance of Wood Treated With Organophosphorus Esters in Combination With Isophorone Diisocyanate

Ellis, W. Dale.
1993. Wood Fiber Sci. 25(3): 236–241.

This research studied the reactions of two polyol phosphorus compounds with a diisocyanate and the properties of wood treated with these chemicals. The isocyanate reacts with hydroxyl groups on the polyols and on the wood to form urethane bonds. Several aspects of the phosphonate-diisocyanate reactions and the resultant flame-retardant wood were evaluated to determine five conditions.

2. Changes in the Size and Volume of Pores in Sweetgum Wood During Simultaneous Rot by *Phanerochaete chrysosporium* Burds.

Flournoy, Douglas S.; Paul, Jennifer A.; Kirk, T. Kent; Highley, T.L.
1993. Holzforschung. 47(4): 297–301.

The purpose of this study was to examine changes in cell wall void (pore) volume and pore size distribution in sweetgum wood during decay by a white-rot fungus, *Phanerochaete chrysosporium* Burds. Results of the study may provide quantitative answers to questions regarding the accessibility of degradative proteins to their respective substrates within the cell wall.

3. Interaction of Sulfur Dioxide and Nitric Oxide With Photoirradiated Wood Surfaces

Hon, David N.-S.; Feist, William C.
1993. Wood Fiber Sci. 25(2): 136–141.

This study investigated the interaction of sulfur dioxide and nitric oxide with wood surfaces that have been activated by ultraviolet light. The rate of interaction of photoinduced wood free radicals with sulfur dioxide and nitric oxide was monitored by an electron spin resonance spectrometer. The formation of sulfonyl and sulfite radicals and nonradical products of nitrite and nitroso are discussed.

4. FT–IR Studies of Weathering Effects in Western Red Cedar and Southern Pine

Horn, Brent A.; Qiu, Jinjin; Owen, Noel L.; Feist, William C.
1992. *In:* Chemical modification of lignocellulosics. FRI Bull. 176. 1992 November 7–8; Rotorua, New Zealand. Rotorua, New Zealand: New Zealand Forest Research Institute: 67–76.

This paper describes the results of using FT-IR spectroscopy to study the chemical effects of weathering. In particular, the effects of light alone, light plus water, and water alone on the weathering in two woods (western redcedar and Southern Pine). Studies also include the depth profile of weathering in western redcedar under different conditions and a comparative study of the effect of weathering on earlywood and latewood (also called springwood and summerwood) on the different wood cuts (radial, cross sectional, and tangential).

5. Wettability of Weathered Wood

Kalnins, Martins A.; Knaebe, Mark T.
1992. J. Adhes. Sci. Technol. 6(12): 1325-1330.

The objectives of the work described in this study were twofold: (1) determine the change in wettability of western redcedar and Southern Pine as a result of weathering and (2) improve videotape procedure for determining contact angles on wood.

6. Determining Paint Adhesion to Wood Using a Uniform Double-Cantilever Beam Technique

Knaebe, Mark; Williams, R. Sam.
1993. J. Test. Eval., JTEVA. 21(4): 272-279.

Accurately predicting paint adhesion without the lengthy time required for typical exposure and evaluation is advantageous. Mechanical tests that use shear block, lap shear, or tensile specimens to measure paint adhesion result in large data variability, making it difficult to differentiate subtle changes in adhesive strength. The objective of this study was to decrease the variability of measured paint adhesion in fracture toughness tests.

7. Proteinases of the Brown-Rot Fungus *Postia placenta*

Micales, Jessie A.
1992. Mycologia. 84(6): 815-822.

The objective of this study was to determine whether differences in proteinase production or regulation in *P. placenta* could be correlated with the ability to decay wood as measured by percentage of weight loss. The quantities of proteinases produced in the presence of different substrates were determined as were the pH optima and colony distribution of the enzymes.

8. The Effects of CCA-Treated Wood on the Performance of Surface Finishes

Ross, Alan S.; Feist, William C.
1993. Am. Paint Coat. J. 78(9): 41-54.

CCA treated wood is widely used in residential and commercial decking—prime substrates for surface finishes. Unfortunately, little information has been published on the effects of CCA treated wood on surface finishes, and many misconceptions exist. This study evaluated the performance of transparent and pigmented commercially available coatings over CCA treated pine and hem-fir compared to controls of untreated wood finished with the same products.

9. Protection of Wood Against Biodeterioration by Chemical Modification

Rowell, R.M.
1993. *In*: Kennedy, J.F.; Phillips, G.O.; Williams, P.A., eds. Cellulosics: Pulp, fibre, and environmental aspects. New York: Ellis Horwood: 473-478. Chapter 70.

This paper reviews the experimental results on the resistance of chemically modified wood to biological attack and drew some conclusions on the mechanism of effectiveness for that resistance.

Chemicals From Wood

10. The Heterogeneous, Dilute-Acid Hydrolysis of Cellulose

Lin, Chyong-Huey; Conner, Anthony H.; Hill, Charles G., Jr.
1993. *In*: Kennedy, J.F.; Phillips, G.O.; Williams, P.A., eds. Cellulosics: Chemical, biochemical, and material aspects. New York: Ellis Horwood: 177-182. Chapter 24.

The results reported in this paper focus on the kinetics of the dilute-acid hydrolysis process. Thirteen prehydrolyzed samples of cellulose, including native, mercerized, and regenerated materials were hydrolyzed in 1, 1.5, and 2 percent sulfuric acid at 150°C, 160°C, 170°C, and 180°C. Pseudo first-order rate constants and weight average degrees of polymerization were determined for each sample. For all cellulose samples, data from several experiments were used to determine the dependence of the rate of hydrolysis on sulfuric acid concentration.

Engineering Properties and Design Criteria

Tensile Strength and Stiffness of Spliced Mechanically Laminated Posts

Bohnhoff, D.R.; Moody, R.C.; Williams, G.D.
1992. Transactions of the ASAE. 35(6): 1965-1972.

Available from American Society of Agricultural Engineers Order Department, 2950 Niles Road, St. Joseph, MI 49085-9659. No charge.

The objectives of this research project were to (1) experimentally determine the tensile strength and stiffness of six commonly used spliced mechanically laminated post designs, (2) compare experimental results to National Design Specifications design values, and (3) determine the ability of a computer program to predict the ultimate tensile strength and stiffness of two post designs.

Bending Properties of STP-Laminated Posts

Bohnhoff, D.R.; Moody, R.C.; Senounci, A.B.; Boor, P.A.
1993. *In*: Proceedings of 1993 ASAE/CSAE international summer meeting; 1991 June 20-23; Spokane, WA. St. Joseph, MI: American Society of Agricultural Engineers. Paper 934060. 21 p.

Available from American Society of Agricultural Engineers Order Department, 2950 Niles Road, St. Joseph, MI 49085-9659. No charge.

The primary objectives of this research project were to (1) optimize the location of shear transfer plates (STP) in three-layer spliced posts with 4-ft overall splice lengths, (2) compare bending stresses and deflections of three-layer, STP-laminated posts with those of nail-laminated posts, and (3) experimentally determine the accuracy of analytical predictions of post stiffness.

11. A Computer Analysis of Moisture Accumulation in the Walls of Manufactured Housing

Burch, D.M.; TenWolde, A.
1993. ASHRAE Transactions. Vol. 99, Part 2, 13 p.

A detailed computer analysis was conducted to investigate the effectiveness of three alternative practices for controlling moisture accumulation in the walls of manufactured housing during the winter. The three practices included (1) providing an interior vapor retarder, (2) using permeable sheathing and siding, and (3) providing an outdoor ventilated cavity.

12. Moisture Content Adjustment Procedures for Engineering Standards

Green, D.W.; Evans, J.W.
1992. *In*: Proceedings, 25th meeting of International Council for Building Structures; 1992 August 24-27; Ahus, Sweden. Ahus, Sweden: CIB-W18. 19 p.

The objective of this paper was to evaluate analytical models for describing the effect of change in moisture content on the bending properties of dimension lumber for five species. This work is limited to models applicable to engineering design codes and to moisture contents of 10 percent or more.

13. Effect of Various Proportions of Juvenile Wood on Laminated Veneer Lumber

Kretschmann, David E.; Moody, Russell C.; Pellerin, Roy F.; Bendtsen, B. Alan; Cahill, James M.; McAlister, Robert H.; Sharp, Donald W.
1993. USDA Forest Serv. Res. Pap. FPL-RP-521. 31 p.

This study demonstrates that a laminated veneer lumber-type product with structural integrity using significant quantities of juvenile wood veneer is possible but will result in products with design values less than those of mature wood. The amount of juvenile wood acceptable to manufacturers will depend on the economic consideration of each manufacturer.

14. Wood Products Used for Residential Repair and Remodeling in the United States, 1991

McKeever, David B.; Anderson, Robert G.
1993. USDA Forest Serv. Resour. Bull. FPL-RB-19. 25 p.

This study addressed wood products consumption in all aspects of residential repair and remodeling. The types and quantities of lumber, structural wood panels (softwood plywood, oriented strandboard, and waferboard), and nonstructural wood panels used for residential repair and remodeling in 1991 are estimated by type of expenditure and project. Regional estimates of use are reported for room and garage additions because regional variations in building styles and preferences directly affect wood use. Detailed procedures used to estimate wood products consumption are presented in an appendix.

15. Two Accelerated-Aging Tests for Wood-Based Panels

McNatt, J. Dobbin; McDonald, Dwight.
1993. Forest Prod. J. 43(7/8): 49-52.

Two simplified accelerated-aging exposures were evaluated and compared as possible alternatives to the current six-cycle test in ASTM D 1037.

16. The Strength of Norwegian Glued Laminated Beams

Solli, Kjell; Aasheim, Erik; Falk, Robert H.
1992. *In*: Proceedings, 25th meeting of International Council for Building Structures; 1992 August 24-27; Ahus, Sweden. Ahus, Sweden: CIB-W18. 8 p.

This paper focuses on the characterization and the performance of glued laminated (glulam) timber beams manufactured from machine stress graded Norwegian spruce in comparison to developing CEN standards. Material properties testing indicated that the supplied laminating timber can be represented by two CEN strength classes, C37-14E and C30-12E, with about 50 percent yield in each class. Beams constructed from these grades exhibited strength and stiffness meeting the requirements of CEN combinations LH35, LH40, and LC38.

17. Specific Gravity, Moisture Content, and Density Relationship for Wood

Simpson, William T.
1993. USDA Forest Serv. Gen. Tech. Rep. FPL-GTR-76. 13 p.

This report reviews the basis for determining values for the density of wood as it depends on moisture content and specific gravity. The data are presented in several ways to meet the needs of a variety of users.

18. Bolted Connection Design Values Based on European Yield Model

Wilkinson, T.L.
1993. J. Struct. Eng. 119 (7): 2169-2186.

This paper discusses the calibration of connection strengths predicted by the European yield model (EYM) to the design values for bolted connections tabulated in the 1986 National Design Specification (NDS). Predicted EYM strengths were compared with 1986 NDS design values to arrive at recommended calibration factors for two- and three-member connections with wood and steel side members loaded parallel and perpendicular to grain over the design space.

19. Bolted Connection Strength and Bolt Hole Size

Wilkinson, T.L.
1993. USDA Forest Serv. Res. Pap. FPL-RP-524. 9 p.

This report presents data for single-bolted timber connections with steel side plates and various sizes of bolt holes. Additional data are presented for connections with various sizes of bolt holes drilled at an angle to the member surface. Load-deformation behavior of connections is compared, and European Yield Model predicted loads are compared to experimental results where applicable.

20. Relationship Between Incipient Decay, Strength, and Chemical Composition of Douglas-fir Heartwood

Winandy, Jerrold E.; Morrell, Jeffrey J.
1993. Wood Fiber Sci. 25(3): 278-288.

The purpose of this study was to explore the relationship between incipient decay, strength, and chemical composition of Douglas-fir heartwood. To accomplish this, a laboratory technique was developed to simulate the initiation of wood decay in natural environments and assess the effects of incipient decay on material properties. Mycelial fragments of selected wood-degrading fungi were used to colonize wood microbeams and then the beams were subjected to matched chemical and mechanical tests.

Fiber and Particle Products

21. Effect of Humidity on Vibrational Properties of Chemically Modified Wood

Akitsu, Hiroshi; Norimoto, Misato; Morooka, Toshiro; Rowell, Roger M.
1993. Wood Fiber Sci. 25(3): 250-260.

This paper is part of a continuing study of the relationship between wood structure and wood properties. In the present work, the longitudinal vibrational properties of eight types of chemically modified wood were determined at four relative humidity levels.

22. Density Range of Compression-Molded Polypropylene-Wood Composites

Geimer, Robert L.; Clemons, Craig M.; Wood, James E., Jr.
1993. Wood Fiber Sci. 25(2): 163-169.

Objectives of this study were to determine (1) the effect of the resin/wood ratio on the range of specific gravities that could actually be achieved in a compression-molded polypropylene-wood composite and (2) the effect of specific gravity on bending and thickness swelling properties.

23. Permanent Fixation of Compressive Deformation of Wood. (II) Mechanisms of Permanent Fixation

Inoue, Masafumi; Morooka, Toshiro; Norimoto, Misato; Rowell, Roger M.; Egawa, Goro.
1992. *In*: Chemical modification of lignocellulosics. FRI Bull. 176. 1992 November 7-8; Rotorua, New Zealand. Rotorua, New Zealand: New Zealand Forest Research Institute: 181-189.

This paper deals with new methods of fixing the compressive deformation permanently. Three kinds of mechanisms for fixing the deformation are described. The first one is to make wood inaccessible to water, the second is to form crosslinking between the wood components, and the third is to release the elastic energy stored by deformation.

24. Steam or Heat Fixation of Compressed Wood

Inoue, Masafumi; Norimoto; Misato; Tanahashi, Mitsuhiko; Rowell, Roger M.
1993. Wood Fiber Sci. 25(3): 224-235.

Dimensional stability can be improved by either steaming or heating wood while the wood is in a compressed state. This study investigated the effect of steam or heat on fixation of compression set and the effect of these treatments on hardness, mechanical properties, and color of compressed and uncompressed wood specimens.

25. Feasibility of Using Recycled Newspapers as a Fiber Source for Dry-Process Hardboards

Krzysik, Andrzej; Youngquist, John A.; Rowell, Roger M.; Muehl, James H.; Chow, Poo; Shook, Steven R.
1993. Forest Prod. J. 43(7/8): 53-58.

Dry-process hardboard represents a favorable option for recycling old newspaper fibers. However, dry-process boards tend to be less dimensionally stable than boards processed by other methods. The objective of this study was to determine the mechanical and physical properties of 3- and 11-mm dry-process hardboards made from various ratios of wood fiber to old newspaper.

26. Chemical Modification of Wood Fiber for Thermoplasticity, Compatibilization With Plastics, and Dimensional Stability

Rowell, Roger M.; Clemons, Craig M.
1992. *In*: Maloney, Thomas M., ed. Proceedings of 26th International particleboard/composite materials symposium; 1992 April 7-9; Pullman, WA. Pullman, WA: Washington State University: 251-259.

Research at the Forest Products Laboratory is focusing on wood fiber/plastic blends and alloys in an attempt to produce materials with consistent, uniform, continuous, predictable, and reproducible properties. The purpose of this paper was to present some of the initial results in the area of wood fiber thermoplasticization.

27. Stability of Acetyl Groups in Acetylated Wood to Changes in pH, Temperature, and Moisture

Rowell, Roger M.; Lichtenberg, Rebecca S.; Larsson, Pia.
1992. *In*: Chemical modification of lignocellulosics. FRI Bull. 176. 1992 November 7-8; Rotorua, New Zealand. Rotorua, New Zealand: New Zealand Forest Research Institute: 33-40.

The purpose of this research was to expose acetylated wood to varying pH, moisture, and temperature conditions and determine loss of acetyl. These data can be used to predict the expected life of an acetylated product under different use conditions.

28. More Rapid Edgewise Crush Test Methods

Urbanik, Thomas J.; Catlin, Arthur H.; Friedman, Davide R.; Lund, Richard C.
J. Test. Eval., JTEVA. 21(1): 62-67.

The primary objectives of the study were twofold: (a) to measure the effects of reconditioning time after waxing on edgewise compressive strength of wax-dipped specimens, using various grades of corrugated fiberboard and conditioned short column specimens and (b) to compare the strength of wax-dipped short column specimens cut and tested in accordance with the ASTM D 2808 Method to the strength of unwaxed specimens cut by the same method but held in the Sumitomo test fixture.

29. Strength Properties of Composites From Biobased and Synthetic Fibers

Young, R.A.; Rowell, R.M.; Sanadi, A.; Clemons, C.
1993. *In*: Kennedy, J.F.; Phillips, G.O.; Williams, P.A., eds. Cellulosics: Chemical, biochemical and material aspects. New York: Ellis Horwood: 453-458. Chapter 66.

This paper gives a brief report on research related to strength properties of mixed fiber composites and describes a new technique to evaluate the interfacial shear strength of wood-thermoplastic systems.

Fire Safety

30. Fire Endurance Model for a Metal-Plate-Connected Wood Truss

White, Robert H.; Cramer, Steven M.; Shrestha, Deepak K.
1993. USDA Forest Serv. Res. Pap. FPL-RP-522. 12 p.

The primary objective of this study was to develop a theoretical model and user-friendly computer program that predicts the fire endurance of a metal-plate-connected wood truss (single-truss model). Extensive component fire testing was conducted to develop the necessary input and submodels for thermal degradation of the wood members and connections.

General

Making Houses Out of Trash

Douglas, Carole.
1993. World Watch. 6(6): 30-32.

Available from World Watch Institute, 1776 Massachusetts Avenue, NW., Washington, DC 20036. Cost: $5.

Although large, fresh-cut logs were once abundant, lumber mills are now learning to make do with smaller logs and engineering systems

to extend the resource base. Ways to stretch the use of wood include using thin wood veneers on visible surfaces, reusing lumber from dismantled buildings, and replacing solid wood beams with laminates made from thin strips of wood that are glued together. In particular, the article talks about the new technique developed at the Forest Products Laboratory that turns used paper, cardboard, and other fibers into lumber, called Spaceboard.

The House That Trash Built

Laufenberg, Ted; Noble, Bob.
1993. Earth Watch Radio Show. [Transcript; audio tape]. January 30.

Available from Ted Laufenberg, Forest Products Laboratory, One Gifford Pinchot Drive, Madison, WI 53705–2398; (608) 231–9480. No charge.

Microbial and Biochemical Technology

31. Recent Advances in the Organization and Regulation of Lignin Peroxidase Genes of *Phanerochaete chrysosporium*

Gaskell, Jill; Cullen, Daniel.
1993. J. Biotechnol. 30: 109–114.

Lignin depolymerization is catalyzed by extracellular peroxidases of white-rot basidiomycetes such as *Phanerochaete chrysosporium*. In submerged culture, production of multiple lignin peroxidase isozymes is derepressed under carbon, nitrogen, or sulfur limitation. The roles of the individual isozymes in lignin degradation and their genetic regulation are poorly understood. This paper reports the recent advances in the organization and regulation of lignin peroxidase genes of *Phanerochaete chrysosporium*.

32. Characterization and *N*-Terminal Amino Acid Sequences of β-(1–4)Endoxylanases From *Streptomyces roseiscleroticus:* Purification Incorporating a Bioprocessing Agent

Grabski, Anthony C.; Forrester, Ian T.; Patel, Rajesh; Jeffries, Thomas W.
1993. Protein Expression and Purif. 4: 120–129.

This paper describes an efficient method for purifying proteins from *S. roseiscleroticus* pigmented fermentation broth. Extracellular xylanases are highly purified using a three-step recovery strategy. The first step is clarification of the fermentation stream using Biocryl BPA-1000; the second step is concentration of the clarified stream by ultrafiltration; the third step is purification of the xylanases by HPLC. All or part of this three-step recovery strategy was applied to a variety of systems where clarification of the feed stream is essential in order to ultimately recover the purified products.

33. Development of Yeasts for Xylose Fermentation

Jeffries, T.W.; Yang, V.; Marks, J.; Amartey, S.; Kenealy, W.R.; Cho, J.-Y.; Dahn, K.; Davis, B.P.
1993. *In*: Klass, D.L., ed. Proceedings of 1st Biomass Congress of the Americas: Energy, environment, agriculture, and industry; 1993 August 30–September 2; Burlington, VT. Golden, CO: National Renewable Energy Laboratory. NREL/CP-200-5768 DE93010050. 2: 1056–1067.

Xylose is an abundant sugar in hardwoods and agricultural residues. Its use is essential for any economical conversion of lignocellulose to ethanol. Only a few yeasts ferment xylose effectively. This paper describes the development of enrichment and selection procedures based on the rapid assimilation of unusual carbohydrates, such as the non-naturally occurring sugar, L-xylose, and the poorly-utilized sugar, L-arabinose.

34. Cloning and Characterization of a cDNA Encoding Glyoxal Oxidase, a H_2O_2-Producing Enzyme From the Lignin-Degrading Basidiomycete *Phanerochaete chrysosporium*

Kersten, Philip J.; Cullen, Daniel.
1993. Proc. Natl. Acad. Sci. USA. 90: 7411–7413.

Glyoxal oxidase is produced by ligninolytic cultures of the white-rot fungus *Phanerochaete chrysoproium* and is a source of the extracellular H_2O_2 that is required by ligninolytic peroxidases. Reported here is the cloning and characterization of glx-1c cDNA, which encodes glyoxal oxidase.

35. Lignin Degradation: Basic Research Progress, and Applications in Soil Remediation and Biopulping

Kirk, T. Kent.
1993. *In*: Kennedy, J.F.; Phillips, G.O.; Williams, P.A., eds. Cellulosics: Pulp, fibre and environmental aspects. New York: Ellis Horwood: 421–430. Chapter 63.

This paper provides an overview of the current understanding of the biochemistry of lignin biodegradation and briefly summarizes research on the use of ligninolytic fungi in bioremediation and biopulping.

36. What Is the Primary Agent of Lignin Degradation in White-Rot Fungi

Kirk, T.K.; Hammel, K.E.
1992. *In*: Kuwahara, M.; Shimada, M., eds. Biotechnology in pulp and paper industry: Proceedings, 5th International conference on biotechnology in pulp and paper industry; 1992 May 27–30; Kyoto, Japan. Tokyo, Japan: Uni Publishers Co., Ltd. 1992: 535–540. Chapter 83.

This paper discusses a number of enzymes that have been proposed to function in fungal ligninolysis, with extracellular lignin peroxidases generally considered the primary agents of this process. However, recent work in three areas suggests that the situation may not be so simple. Several white-rot basidiomycetes have been reported to degrade lignin without producing detectable lignin peroxidase activity. Electron microscopic studies do not clearly show that enzymes are responsible for early stages of wood decay. It has been difficult to demonstrate ligninolysis by isolated lignin peroxidases in vitro. These results indicate that some ligninolytic agent other than lignin peroxidase is produced by white-rot fungi.

37. The Potential of White-Rot Fungi in Bioremediation

Kirk, T. Kent; Lamar, Richard T.; Glaser, John A.
1992. *In*: Mongkolsuk, S.; Lovett, P.S.; Trempy, J.E., eds. Biotechnology and environmental science-molecular approaches. Proceedings of an international conference on biotechnology and environmental science: molecular approaches; 1990 August 21–24; Bangkok, Thailand. New York: Plenum Press: 131–138.

This paper concerns the deliberate harnessing of lignin-degrading fungi for remediating soils contaminated with hazardous organic chemicals. The fungi, their ligninolytic system, and the compounds that they degrade are described. Then, laboratory and field studies with the wood preservative pentachlorophenol, which were selected as a target chemical, are briefly summarized.

38. Chromophore Release From Kraft Pulp by Purified *Streptomyces roseiscleroticus* Xylanases

Patel, R.N.; Grabski, A.C.; Jeffries, T.W.
1993. Appl. Microbiol. Biotechnol. 39: 405-412.

This study sought to clarify the roles of individual xylanase isoenzymes in facilitating bleaching and to elucidate the nature of the chromophore released.

39. Role of Organic Acid Chelators in Manganese Regulation of Lignin Degradation by *Phanerochaete chrysosporium*

Perez, J.; Jeffries, T.W.
1993. Appl. Biochem. Biotechnol. 39/40: 227-238.

This article describes the role of organic acids in maintaining (or inhibiting) manganese peroxidase and lignin peroxidase activities. Lignin depolymerization, mineralization, and distribution of the degradation products in the culture were also followed as a function of manganese concentration and enzymatic activity.

40. Extracellular Enzyme Production and Synthetic Lignin Mineralization by *Ceriporiopsis subvermispora*

Rüttimann-Johnson, Carmen; Salas, Loreto; Vicuna, Rafael; Kirk, T. Kent.
1993. Appl. Environ. Microbiol. 59(6): 1792-1797.

The aim of this study was to examine relationships between the rates of synthetic lignin mineralization and the levels of MnP and laccase produced by *C. subvermispora.* It was of interest to study this fungus because it does not produce LiP but degrades substantial amounts of lignin in wood. It is also of considerable interest as the best biopulping fungus described to date.

41. Identification of the Gene Encoding the Major Cellobiohydrolase of the White Rot Fungus *Phanerochaete chrysosporium*

Vanden Wymelenberg, Amber; Covert, Sarah; Cullen, Daniel.
1993. Appl. Environ. Microbiol. 59(10): 3492-3494.

Previous studies have shown that the cellobiohydrolases of the white-rot basidiomycete *Phanerochaete chrysosporium* are encoded by a family of structurally related genes. In this investigation, the most highly transcribed gene, *cbhl-4*, was identified and sequenced. Evidence suggests that in this fungus the dominant isozyme, CBH1, is encoded by *cbhl-4*.

Mycology

The Use of Isozyme Analysis for Identification of Plant-Pathogenic Fungi

Bonde, Morris R.; Micales, Jessie A.; Peterson, Gary L.
1993. Plant Disease. 77(10): 961-968.

Available from Morris R. Bonde, USDA-ARS, Foreign Disease-Weed Science Research, Building 1301, Fort Detrick, Frederick, MD 21702. No charge.

Isozyme analysis is a powerful biochemical technique that has numerous applications in plant pathology. This paper discusses the advantages and disadvantages of isozyme analysis over other identification techniques and describes how isozyme studies can be designed to differentiate pathogens.

42. Taxonomic Mycology: The Good, the Bad, the Optimistic

Burdsall, Harold H., Jr.
1993. Mushroom J.: 17-19.

This paper is written by a 26-year veteran taxonomic mycologist. He presents his views for the future of providing such taxonomically trained mycologists because so few are coming out of the universities today. He discusses such matters as getting the support of user groups that taxonomists need. He feels that it is absolutely mandatory that taxonomists take more time with their work, looking at the total biology of the organisms relating the species to their natural environment as well as studying their similarities and differences in the laboratory.

Processing of Wood Products

Monitoring Tensile Strength of End-Jointed Lumber Using Ultrasonics

Han, M.B.; Bender, D.A.; Ross, R.J.; Bray, D.E.
1992. *In*: Proceedings, American Society of Agricultural Engineers Paper No. 924546, 1992 December 15-18; Nashville, TN. 18 p.

Available from American Society of Agricultural Engineers, 2950 Niles Road, St. Joseph, MI 49085-9659. Cost: $7 plus $3.50 shipping and handling.

The goal of this research was to explore nondestructive evaluation (NDE) techniques to predict end joint strength. It is envisioned that ultimately this technology would lead to continuous, real-time monitoring of end joint quality. Although periodic off-line destructive testing still would be required to update the NDE database, it is likely that less testing would be needed. Potential benefits to the forest products industry include enhanced customer confidence in engineered products, higher allowable design values, less rejected end joint and downtime, and less liability exposure.

43. Mathematical Relationship Between Desorption and Sorption Solutions

Liu, Jen Y.
1993. Drying Technol. 11(5): 961-975.

This paper presents a theoretical equation relating the dimensionless times of Newman's solutions of the diffusion equation for desorption and sorption. The derived equation provides a theoretical proof of the linear relationship between dimensionless time and the inverse of transport ratio for a given fraction of diffusing substance as observed numerically in the literature.

44. Lumber Recovery From Pacific Yew Logs: An Exploratory Study

Loehnertz, Stephen P.; Lowell, Eini C.; Simpson, William T.; McDonald, Kent A.
1993. USDA Forest Serv. Res. Pap. FPL-RP-525. 7 p.

In the past several years, thousands of Pacific yew trees were stripped of their bark from which the cancer-fighting compound taxol is obtained. Research has determined that the wood from the Pacific yew does not yield enough taxol to supplement the supply from the bark. The objectives of this study were to assess the quantity and quality of lumber that could be produced from debarked yew logs.

45. Determination and Use of Moisture Diffusion Coefficient to Characterize Drying of Northern Red Oak (*Quercus rubra*)

Simpson, W.T.
1993. Wood Sci. Technol. 27: 409-420.

The primary objectives of this research were (1) to determine the diffusion coefficient of northern red oak (*Quercus rubra*) as a

function of moisture content and (2) to compare experimentally determined sorption times and moisture content gradients with those calculated by the diffusion model. Further objectives were to illustrate how the diffusion model can describe kiln drying after predrying to below the fiber saturation point and how sensitive the model predictions are to variations in kiln conditions and board characteristics.

46. Quality Drying in a Hardwood Lumber Predryer: Guidebook-Checklist

Wengert, Eugene M.; Boone, R. Sidney.
1993. USDA Gen. Tech. Rep. FPL-IMP-GTR-3. 32 p.

The IMPROVE Lumber Drying Program is intended to increase awareness of the lumber drying system as a critical component in the manufacture of quality lumber. This report is one component of the IMPROVE Program. It is a guidebook-checklist for quality drying in a hardwood lumber predryer that kiln/predryer operators or owners can use to readily evaluate how well their operations rate on those factors that most strongly affect drying quality, with particular emphasis on predryer operation and maintenance and lumber handling.

Pulp, Paper, and Packaging

47. The White-Rot Fungus *Ceriporiopsis subvermispora* Saves Electrical Energy and Improves Strength Properties During Biomechanical Pulping of Wood

Akhtar, M.; Attridge, M.C.; Blanchette, R.A.; Myers, G.C.; Wall, M.B.; Sykes, M.S.; Koning, J.W., Jr.; Burgess, R.R.; Wegner, T.H.; Kirk, T.K.
1992. *In*: Kuwahara, M.; Shimada, M., eds. Biotechnology in pulp and paper industry: Proceedings, 5th International conference on biotechnology in pulp and paper industry; 1992 May 27-30; Kyoto, Japan. Tokyo, Japan: Uni Publishers Co., Ltd.: 3-8. Chapter 1.

Currently used chemical pretreatments for mechanical pulping have the advantage of increasing paper strength, but have the disadvantages of being capital- and energy-intensive, giving low yields, and producing troublesome wastewater streams that require costly treatment. To overcome some of these problems, the possibility of using biological pretreatments was examined. During such pretreatments, wood chips were "softened" by lignin-degrading (white-rot) fungi. The objective was to find a fungus that is effective with both hardwood and softwood species.

48. Tax Incentives to Stimulate Investment in Recycling

Alig, Joanne T.
1993. Progress in Pap. Recycling. 3(1): 52-56.

This article presents an overview of tax incentives and summarizes state tax incentives aimed at stimulating investments in recovery or reprocessing of recovered materials. Many states have implemented tax incentives because they believe society will benefit from higher employment, reduced disposal of materials in landfills, and reuse of those materials.

49. Hemicelluloses as Structure Regulators in the Aggregation of Native Cellulose

Atalla, R.H.; Hackney, J.M.; Uhlin, I.; Thompson, N.S.
1993. Int. J. Biol. Macromol. 15: 109-112.

The influence of hemicelluloses on the aggregation of cellulose in higher plant cell walls was modeled by adding hemicelluloses to cultures of the cellulose producer *Acetobacter xylinum*. Characterization of the celluloses by X-ray diffractometry showed them to be more like those that occur in higher plants; the coaggregation of the hemicelluloses suggests their occlusion within and between the crystalline domains of the celluloses. The authors propose that hemicelluloses may be primary moderators of the tertiary structure of cell wall celluloses, allowing the development of a wide range of properties.

50. United States Pulpwood Receipts: Softwood and Hardwood, Roundwood and Residues, 1950-1989

Ingram, C. Denise; Durbak, Irene; Ince, Peter.
1993. USDA Gen. Tech. Rep. FPL-GTR-73. 40 p.

This report shows pulpwood receipts at pulp mills in the United States from 1950-1989. It is a compilation of published and estimated data based on information from various sources, including the American Pulpwood Association, American Paper Institute, U.S. Bureau of the Census, and the USDA Forest Service. Trends are shown in the use of hardwoods compared to softwoods and residues compared to roundwood, by the Forest Service timber supply regions. These historical data were compiled to help develop new pulpwood supply functions for the Timber Assessment Market Model and the North American Pulp and Paper Model of the USDA Forest Service.

51. Improving Interfibre Bonding of Recycled Fibres

Minor, J.L.; Atalla, R.H.; Harten, T.M.
1993. J. Pulp Pap. Sci. 19(4): J152-J155.

Gas phase treatments of dry-fiberized newsprint were investigated as a way to improve interfibre bonding and thereby to minimize the use of water for recycling newsprint. Chlorine dioxide, nitrogen dioxide, and ozone were studied as gaseous oxidizing agents. The report includes the results of an optimization study for the ozone treatment and results of experiments designed to establish the mechanism by which ozone enhances interfibre bond strength.

52. Treatment of Softwood Kraft Pulps With Peroxymonosulfate Before Oxygen Delignification

Springer, Edward L.; McSweeny, James D.
1993. Tappi J. 76(8): 194-199.

This study examines peroxymonosulfate as an oxidative pretreatment before oxygen delignification to allow greater lignin removal and thus reduce the chlorinated organic compounds emitted from the later bleaching stages. A preliminary treatment with a chelating agent or a mineral acid to remove transition metals was essential before the peroxymonosulfate pretreatment.

53. Bleaching and Brightness Stability of Aspen Biomechanical Pulps

Sykes, Marguerite.
1993. Tappi J. 76(11): 121-126.

This study comprised two related parts. The first established the bleachability and brightness stability of aspen biomechanical pulping (BRMP) compared with that of nutrient-enriched, incubated aspen refiner mechanical pulp controls. This pretreatment of the control was included to isolate the effect of the fungus on the resulting pulp and paper properties. The second part compared bleachability and brightness stability of aspen BRMP with those of other aspen mechanical pulps, such as chemithermomechanical pulp, thermomechanical pulp, and groundwood pulp.

54. Fourier Transform Raman Spectroscopic Studies of a Novel Wood Pulp Bleaching System

Weinstock, Ira A.; Atalla, Rajai H.; Agarwal, Umesh P.; Minor, James L.
1993. Spectrochimica Acta. 49A(5/6): 819-829.

In this report, the use of near-infrared (NIR) Fourier transform (FT)-Raman spectroscopy for the study of lignocellulosic materials is discussed. An application utilizing NIR FT-Raman spectroscopy to study a novel chlorine-free process for the bleaching of wood pulps is also presented in detail.

55. The Influence of Moisture Content on the Nonlinear Constitutive Behavior of Cellulosic Materials

Yeh, K.C.; Considine, J.M.; Suhling, J.C.
1991. *In*: TAPPI Proceedings, International paper physics conference: 695-711.

In this project, the effect of moisture on the mechanical behavior of paperboard was investigated. In particular, experiments under controlled environmental conditions were performed to determine the effects of moisture content on the machine direction and cross-machine direction initial elastic moduli, Poisson's ratios, initial shear modulus, and shapes of the machine direction and cross-machine direction uniaxial stress-strain curves.

Timber Requirements and Economics

56. Dissolving Pulp Industry: Market Trends

Durbak, Irene.
USDA Forest Serv. Gen. Tech. Rep. FPL-GTR-77. 20 p.

This report presents a worldwide overview of the dissolving pulp industry and highlights of this industry in Alaska. It describes trends in world markets and major end-use markets, with special emphasis on the manufacture and use of textile fibers in the United States. Figures and tables present data on production, consumption, and trade of dissolving pulp and the cellulosic fibers—rayon and acetate—produced from it. Data are also given on the production and use of competing natural and synthetic fibers, such as cotton, silk, nylon, and polyester.

57. Northeast Economic Data and Retrieval System

Spelter, Henry; Ghosh, Sujata.
1993. USDA Forest Serv. Gen. Tech. Rep. FPL-GTR-78. 7 p.

To help foster rural economic development in 18 Northeastern states, an economic information system developed at the USDA Forest Service, Forest Products Laboratory was used to facilitate access to reference data on forest products industry activities. This report explains the computerized system and provides instruction for users.

58. PELPS III: A Microcomputer Price Endogenous Linear Programming System for Economic Modeling

Zhang, Dali; Buongiorno, Joseph; Ince, Peter J.
1993. USDA Forest Serv. Res. Pap. FPL-RP-526. 43 p.

This document provides documentation and user information for PELPS III, a microcomputer *P*rice *E*ndogenous *L*inear *P*rogramming *S*ystem for economic modeling. Originally developed for the North American pulp and paper industry, PELPS III can be used for any sector to predict consumption, production, and capacity by technology, and trade within or among several regions or countries. The theoretical structure is that of spatial equilibrium modeling under competitive market assumptions. This document contains a detailed user's guide, an application of PELPS III, and a mathematical description of the model. A glossary of terms is also included.

Tropical Wood Utilization

59. Forest Products From Latin America—Annotated Bibliography of World Literature on Research, Industry, and Resource of Latin America 1915 to 1989

Maeglin, Robert R.; Boone, R. Sidney.
1993. USDA Forest Serv. Gen. Tech. Rep. FPL-GTR-79. 120 p.

This document provides more than 4,000 citations from the world literature on forest products for Latin America. Citations are grouped in 11 subject areas, with emphasis on products made directly from wood. Excluded are nonwood products such as rattan, bamboo, nuts, fruits, honey, and mushrooms. Primary sources of citations include USDA-AGRICOLA, CAB, and Forest Products Society's FOREST (AIDS) system, which were searched electronically.

Wood Bonding Systems

60. Polyamine-Modified Urea-Formaldehyde-Bonded Wood Joints. III. Fracture Toughness and Cyclic Stress and Hydrolysis Resistance

Ebewele, Robert O.; River, Bryan H.; Myers, George E.
1993. J. Appl. Polym. Sci. 49: 229-245.

The objective of this study was to improve the durability and stability of urea-formaldehyde-bonded wood products by decreasing the internal stress developed during the resin cure and by improving the ability of the cured system to withstand cyclic stresses. Urea-formaldehyde resins were modified either by incorporating urea-capped di- and trifunctional amines into the resin structure or by using the hydrochloride derivatives of some of these amines as the curing agent, or by both methods. This study supplements the author's previous work by examining the effects of additional amines and subjecting bonded products to additional testing.

61. Development of Dynamic Mechanical Methods to Characterize the Cure State of Phenolic Resole Resins

Follensbee, R.A.; Koutsky, J.A.; Christiansen, A.W.; Myers, G.E.; Geimer, R.L.
1993. J. Appl. Polym. Sci. 47: 1481-1496.

This article primarily discusses the development of dynamic mechanical analysis procedures that will provide reproducible and interpretable data for phenol-formaldehyde resole resins. Procedures were developed that permit the obtaining of data that properly characterize and quantify the dynamic mechanical analysis (DMA) behavior of these aqueous systems. This report illustrates the problems encountered and the steps that we adopted to resolve them.

62. Determination of Furan-Based Amines in Reaction Mixtures by Gas Chromatography

Holfinger, Michael S.; Conner, Anthony H.; Hill, Charles G., Jr.
1993. J. Chromatog. 644: 383-387.

A protocol that employs a methyl silicone gum capillary column for gas chromatographic analysis of the products of the acid-catalyzed reaction of furfurylamine with aldehydes is presented, and its efficacy is demonstrated.

63. Difurfuryl Diisocyanates: New Adhesives Derived From Renewable Resources

Holfinger, Michael S.; Conner, Anthony H.; Lorenz, Linda F.; Hill, Charles G., Jr.
1993. J. Appl. Polym. Sci. 49: 337-344.

To determine if difurfuryl diisocyanates are comparable to diphenylmethane diisocyanate (MDI) in wood-bonding properties, the mechanical property values of flakeboards bonded with one difurfuryl diisocyanate reported in the literature [i.e., ethylidenebis(2,5-furandiylmethylene) diisocyanate (EDFI)] were compared with those of flakeboards bonded with MDI. In a previous study, flakeboards were bonded with EDFI that had been diluted with chloroform. The chloroform lowered the viscosity of the EDFI resin and made it easier to spray, but chloroform also had a detrimental effect on the mechanical properties of the flakeboards. In the study reported here, the experiments from the previous study were repeated without dilution of the EDFI resin with chloroform.

64. Adhesive Bonding of Acetylated Pine and Spruce

Larsson, Pia; Mahlberg, Riitta; Vick, Charles; Simonson, Rune; Rowell, Roger M.
1992. *In*: Chemical modification of lignocellulosics. FRI Bull. 176. 1992 November 7-8; Rotorua, New Zealand. Rotorua, New Zealand: New Zealand Forest Research Institute: 16-24.

In this study, bonding properties of four conventional wood adhesives were determined on acetylated pine (*Pinus silvestris* L.) and spruce (*Picea abies* Karst.). The adhesives chosen for the study were a resorcinol-formaldehyde, a phenol-resorcinol-formaldehyde, a cross-linked polyvinyl acetate, and an emulsion polymer isocyanate adhesive, respectively. The effects of different degree of acetylation in adjacent lamina were also examined.

65. Structural Bonding of Acetylated Scandinavian Softwoods for Exterior Lumber Laminates

Vick, C.B.; Larsson, P.Ch.; Mahlberg, R.L.; Simonson, R.; Rowell, R.M.
1993. Int. J. Adhes. and Adhes. 13(3): 139-149.

The bonding properties of a resorcinol-formaldehyde, a phenol-resorcinol-formaldehyde, a crosslinking polyvinyl acetate, and an emulsion polymer-isocyanate adhesive were determined in laminates of acetylated and unmodified Scandinavian pine (*Pinus silvestris* L.) and spruce (*Picea abies* Karst.). The effects of different degrees of acetylation in adjacent laminae were also examined.

Special Items

Biopulping—A Glimpse of the Future?

Kirk, T. Kent; Koning, John W., Jr.; Burgess, Richard R.; Akhtar, Masood; Blanchette, Robert A.; Cameron, Douglas C.; Cullen, Daniel; Kersten, Philip J.; Lightfoot, Edwin N.; Myers, Gary C.; Sachs, Irving; Sykes, Marguerite; Wall, Mary Beth.
1993. USDA Forest Serv. Res. Pap. FPL-RP-523. 74 p.

Available from Forest Products Laboratory, One Gifford Pinchot Drive, Madison, WI 53705–2398. No charge.

This is the final report of Biopulping Consortium I, a 5-year research and information program involving the USDA Forest Service, Forest Products Laboratory, the University of Wisconsin, and industry. The objective of the Consortium research was to evaluate the technical feasibility of biopulping, defined as the fungal pretreatment of wood for pulping. The research focused on mechanical pulping, specifically on energy savings for the pulping itself, and on paper properties. Past work on biopulping has been minimal, but generally encouraging. In addition to the research objective, the Consortium served an information and education function, interfacing the industrial partners with developments in biotechnology.

The overall conclusion of this 5-year research effort is that biopulping works. Through the use of the proper lignin-degrading fungi, significant energy is saved in mechanical pulping, and paper strength properties are enhanced. Optical properties are diminished; however, brightness can be restored readily by bleaching. The process appears to be less polluting than chemi-mechanical processes, and the economics look favorable if the process can be performed in a chip pile-based system.

Edging and Trimming Analysis Routine—Procedures Guide

State and Private Forestry
1993. USDA Forest Service. 44 p.

Available from Forest Products Laboratory, Forest Products Conservation & Recycling Technology Marketing Unit, One Gifford Pinchot Drive, Madison, WI 53705–2398; (608) 231–9352.

The *Edging & Trimming Analysis Routine—Procedures Guide* describes the procedures necessary to successfully conduct an edging and trimming study. The Guide is designed to be used in conjunction with the Edging & Trimming Analysis computer program. Reports produced by the computer program help evaluate the edging and trimming practices currently employed in a mill. By identifying, measuring, and grading flitches, both before and after being edged and end trimmed, poor practices can be uncovered. Correcting poor practices can lead to improved yield and product value. The information gained through this analysis can aid top management in devising a strategy for improving their edging and trimming practices.

Income Opportunities in Special Forest Products—Self-Help Suggestions for Rural Entrepreneurs

Thomas, Margaret G.; Schumann, David R.
1993. USDA Forest Serv. Agric. Infor. Bull. 666. 206 p.

Available from Forest Products Laboratory, One Gifford Pinchot Drive, Madison, WI 53705–2398. No charge.

For many rural areas, the path to sustainable economic development will include innovative approaches to natural resource conservation, management, and utilization. This publication describes special forest products that represent opportunities for rural entrepreneurs to supplement their incomes. The types of products discussed in this publication include aromatics, berries and wild fruits, cones and seeds, forest botanicals, honey, mushrooms, nuts, syrup, and weaving and dyeing materials. Each chapter describes market and competition considerations, distribution and packaging, equipment needs, and resource conservation considerations, and presents a profile of a rural business marketing the products. In general, products suitable for very small or part-time operations are described. A suggested role for each type of microenterprise within a broader rural economic development framework is also mentioned. Each chapter concludes with a list of contributors and additional resources.

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